6.—THE PALAEONTOLOGY OF THE PLANTAGENET BEDS OF WESTERN AUSTRALIA.

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I.—INTRODUCTION.

In 1917 Messrs. J. T. Jutson, B.Sc., LLB., and E. S. Simpson, B.E., D.Sc., F.A.C.I., favoured us with a large collection of Cainiozoic fossils, including those which they had obtained from Albany, and those which members and correspondents of the Geological Survey had obtained from Cape Riche and Norseman, Western Australia. This fossiliferous series they had already named as "The Plantagenet Beds." (Jutson and Simpson, 1915, p. 48.)

The collection as it is now described in detail comprises all the above-mentioned specimens, and we are further indebted to the Curator of the Western Australian Museum, Mr. L. Glauert, B.A., F.G.S., for a further collection of fossils, chiefly mollusca, and to Mr. T. Blatchford, B.A., late Government Geologist of Western Australia, for a very extensive collection of fossil sponges he had collected in the Hamersley River District.

A few years ago a paper on the Jutson and Simpson collections was published under the title of some "Preliminary Notes on the Fauna and Age of the Plantagenet Beds of Western Australia," by the present authors, and was issued in the Report of the Australasian Association for the Advancement of Science for 1924 (Chapman and Crespin, 1926, pp. 319–322). This paper has an epitomy of the results of an examination of the Jutson and Simpson collections. The present paper represents a detailed study of the earlier collection referred to, with the addition of a description of the Glauert collection.

Since the preliminary paper above referred to was published, L. Glauert has given a supplementary list of Western Australian Fossils (Glauert, 1926, pp. 62, 63), in which he included the names of some mollusca from these beds, which, although not precisely stated, appear to be Glauert's own determination of some specimens in the collection of the Western Australian

Museum. These were apparently provisional, and in certain cases appear to differ from similar forms which Miss Crespin and I have recorded in the preliminary paper. Mr. Glauert kindly forwarded the above collection, together with a supplementary one of fossil sponges from the Geological Survey of Western Australia to the National Museum, Melbourne, for our examination, and this was received on the 12th October, 1927. These series, including the types, will be returned to the Western Australian Museum and Art Gallery, and Geological Survey, at the conclusion of the work.

In a paper published in 1924 on the Geology of the Mineral Industry in Western Australia, by A. Gibb Maitland and A. Montgomery (Maitland and Montgomery, 1924), there are references to the Western Australian Tertiary rocks on pages 41 to 45, and on page 41, fig. 16, is a striking photograph of the type of stratification seen in the limestone cliffs at Twilight Cove, Eyre.

For detailed references to papers relating to the occurrence of fossils belonging to the Plantagenet Series, down to 1919, the reader is referred to "Preliminary Notes on the Fauna and Flora of the Plantagenet Beds of Western Australia" (Chapman and Crespin, 1926, pp. 319, 320).

Some years ago one of us gave a list of Miocene fossils from the Ooldea District in the western part of South Australia (Chapman, 1920, pp. 243 and 244), which comprises a large percentage of mollusca common to that area and the Plantagenet beds of Western Australia. L. Glauert (1926, pp. 61–63) has also listed the Cainozoic fossils of Western Australia, comprising Hinde's determinations of the "Princess Royal" sponge-remains, J. W. Gregory's polyzoa, and his own records of mollusca, etc. from the Plantagenet beds. In this list, the series of foraminifera from the Cape Range is omitted, as also the names of the fossils from the Albany and Cape Riche beds collected by Jutson and Simpson (Chapman and Crespin, 1926), which latter paper, however, was possibly not published before this list of the same year. As already indicated, the fossils referred to in Glauert's list of 1926, have been kindly loaned by Mr. Glauert through the National Museum.

II.—THE ALBANY, CAPE RICHE, AND NORSEMAN BEDS—STRATIGRAPHICAL AND LITHOLOGICAL NOTES.

The variably constituted sediments which Messrs. J. T. Jutson and E. S. Simpson have named the Plantagenet Series (Jutson and Simpson, 1917, p. 48), and "believe - - - will ultimately be determined as of Miocene age," have since been conclusively proved to belong to that period (Chapman and Crespin, 1926, p. 321). Jutson and Simpson wrote their statement as to probable age in 1915, but their paper was not published until 1917 ; meanwhile J. W. Gregory had published a note in the Geological Magazine in 1916, giving the evidence of mollusca determined by A. E. Kitson, and of polyzoa by himself (Gregory, 1916, pp. 320–321). Professor Gregory stated that "their evidence is in favour of the Miocene rather than of the Pleistocene age of the Norseman Limestone" (*loc. cit.*, p. 321).

The sediments comprised in the Plantagenet Series were laid down in hollows on a granite platform. This granite has been intersected in places by basic dykes (dolerite and basalt), ranging in width from less than an inch to many yards. One dyke (a supposedly later intrusion) cuts through granite and Miocene sediment alike (Jutson and Simpson, 1917, p. 48).

The variation in the types of Miocene sediments represented in the present collection is considerable, and from each locality the fossiliferous specimens will be examined in detail. Overlying the Plantagenet beds, especially

nearer the Coast is an accumulation of dune limestone, which Jutson and Simpson have named the Darwin Ridge in honour of Darwin, who made observations here, at Bald Head during the voyage of the "Beagle." Probably the age of these consolidated dunes is similar to that of the dunes at Sorrento, Warrnambool, and other localities along the Victorian Coast. In the present case, as Jutson and Simpson remark, "they were formed subsequent to the deposition and uplift of the Plantagenet Marine beds."

These Pleistocene deposits may be closely compared with those of the Ooldea region, near the western border of South Australia, where I have recorded (Chapman, 1920, p. 245) an uplift of 381 feet, and extending as far inland as 100 miles. This was referred to in the paper mentioned as Older Pleistocene, since it was overlain in places by the raised beach formations during sub-recent movements.

THE ALBANY AND CAPE RICHE SEDIMENTS.

This series is typically exposed in a brick-pit three miles north-west of Albany. The beds have been laid down on an irregular granitic surface and retain their original horizontal position, notwithstanding subsequent elevation and depression. "The Plantagenet beds near Albany rise to a height of 170 to 220 feet or more above sea-level, but their maximum thickness is not known" (Jutson and Simpson, 1917, p. 52).

These sediments consist of fine-grained siliceous rocks, varying from white to pale pink and yellowish brown. The Albany siliceous rock is moderately friable, whilst that from Cape Riche is much more tenacious. The material appears to be largely derived from the detritus of siliceous sponge spicules, and there are numerous casts and moulds of fossils shown on fractured surfaces. Wax or plasticene squeezes from these often yield good results in the determination of genera, and even species of mollusca and echinoids. Faithful impressions of leaves have been formed in the more solid siliceous rock of Cape Riche. Messrs. Jutson and Simpson (1917, pp. 48, 49) remark about the Albany rock that "Siliceous sponges are especially abundant throughout these beds, many complete skeletons of lithistids being obtainable, whilst isolated spicules of the same and of tetractinellids form an important proportion of the whole rock." In addition, those authors note, the uniformly fine grain of the rock, the small proportion of kaolin, almost total absence of calcium or magnesium carbonates, the larger proportion of purely siliceous material present (83·62% in the white stone of Cape Riche, and 82·58% in the yellow).

A microscopic examination of the powdery residue washed from the Albany siliceous rock shows numerous broken sponge spicules, minute irregular quartz grains, a fair proportion of foraminiferal casts (*Spiroplectammina* and *Discorbis*), together with about 50% of a fine siliceous silt.

The siliceous rocks from Cape Riche that we have examined are largely composed of sponge spicules, generally broken and worn into a fine mud, but in some cases the rock is of a clean spicular type. As a rule the spicules are best seen in the whitish rock, whilst that with the yellow sandy matrix carries the impressions of leaves, and moulds and casts of molluscan shells.

NORSEMAN.

This locality is represented by hard, siliceous, or jasperised shelly, and polyzoal limestones. These were collected by Dr. E. S. Simpson. In parts the rock is ochreous, or otherwise ferruginous, and of a yellow to reddish

brown colour. It appears to be without a trace of calcareous matter. The polyzoa and mollusca are conspicuous on the weathered surfaces of the slabs, but are not very well preserved, so that determination is difficult. This deposit was probably laid down in moderately deep water.

The sponge spicule deposit of the Princess Royal Deep Lead, Lake Cowan, Norseman District, was described by Dr. Hinde (Hinde, 1910), to whom it was sent by A. Gibb Maitland, then Director of the Geological Survey of Western Australia, a few months before that date. From available details of the occurrence of this spicule bed one is justified in doubting that this is a true Deep Lead, for the adjoining surface is a kaolinized deposit, "probably mostly decomposed rock in situ" (Hinde, 1910, p. 7), with the spicule deposit evidently lying upon it as a remanie layer related to the sponge bed elsewhere found at Albany.

The rock examined by Dr. Hinde, which yielded such a large variety of sponge remains, is of quite a different nature to the samples submitted to us by Messrs. Jutson and Simpson, as above-mentioned. The deposit described by Hinde (1910, p. 8) consisted "of a very light, whitish, finely granular, and powdery material, which is so incoherent, tender, and friable that it readily breaks up into dusty powder between the fingers, and when treated in water with a soft brush it passes into a greyish mud. It may be said to be an aggregation of fine particles without any cementing material to bind them together. There is no indication of bedding to be seen in the lumps. Treated with dilute hydrochloric acid, the rock shows no reaction whatever."

Dr. Hinde found the rock, under a lens, to be "composed" of minute glassy rods and granules, and occasionally of entire sponge spicules. He also notes "some minute grains of a dark mineral, and also more numerous clear granules, mostly of quartz." The only organic remains that Dr. Hinde found in this rock belonged to the siliceous sponges, and his identifications are included in our complete list of fossils at the end of Section III.

The only material we have seen resembling that described by Hinde from the Norseman (?) Deep Lead in the other collections, is a small sample included in the Albany Series, sent by Dr. Simpson.

Another phase of rocks in the Norseman district occurs as patches of limestone found on the surface of the Dundas Goldfield at an altitude of 900 feet above sea level, and 100 miles from the coast. These limestones, of which our present samples appear to be a silicified modification, were described by Professor J. W. Gregory (1916, p. 320), who gave some determinations of the included fossil polyzoa and a short list of the mollusca identified by A. E. (now Sir Albert) Kitson. These are also included in our list at the end of Section III.

The geological occurrence of the Norseman beds has been dealt with by A. Gibb Maitland (1908, p. 153) and by W. D. Campbell (1906, p. 22).

LOCALITIES AND OCCURRENCE OF TERTIARY FOSSILS LOANED FROM THE MUSEUM AND ART GALLERY, PERTH, AND FROM THE W. A. GEOLOGICAL SURVEY, 12TH OCTOBER, 1927.

List furnished by L. Glauert, F.G.S. Notes by present authors.

Albany District. *Nos.* 6041–6043.
(Shell casts in whitish siliceous rock).

Near Cheyne Beach. *Nos.* 6039, 6040
(Fossil casts in whitish siliceous rock).

Brick Works, 3 miles N.E. Albany. *Nos.* $\frac{1}{41351}$ (1–5).
(Casts of fossils in whitish siliceous rock).

Hassell's Homestead. *Nos.* $\frac{1}{41356}$ (1–3).
(Hard yellowish siliceous rock with casts and moulds of molluscan shells).

Hassell's Road, 10 miles Cheyne Beach. *Nos.* 5435–6.
(Yellowish spongy siliceous rocks with shell impressions.)

King River, Near Albany. *Nos.* 6044–6.
(Fossil casts and impressions in ironstone).

Warriup Homestead. *Nos.* $\frac{1}{41353}$ (1–4).
(Casts of mollusca in silicified limestone).

Sugar Bag Creek, Albany. *Nos.* $\frac{1}{41352}$ (2, and 5–9).
(Fossil impressions and casts in spicular chert. Similar to Warriup Homestead).

Hill, 1 mile from Warriup Homestead. *Nos.* $\frac{1}{41354}$ (3).
(A siliceous sponge replaced by ironstone).

Bremer Bay. *Nos.* G3726 and 6049–54.
(Casts of fossils in pink to brown limestone).

Hamersley River District, East of Albany.

Nos. $\frac{1}{H27}$, $\frac{1}{3903}$, $\frac{1}{3964–7}$, $\frac{1}{3969–71}$, $\frac{1}{3977–82}$, $\frac{1}{3984–94}$.

(A rich sponge bed, of siliceous forms, in which the entire sponge-body is often extremely well preserved. At times the sponges have their siliceous character almost replaced by limonite, and thus pass into a ferruginous earth).

Cape Riche. *Nos.* 277–279, 309, 314, 405, 5718.
(Casts and impressions of leaves, shells and echinoids, in a whitish fawn-coloured siliceous rock).

Balladonia, Eucla District. *Nos.* 3247–63.
(Fossils, chiefly as casts and moulds, in pale reddish limestone, of Miocene age. Also hard grey limestone of Upper Miocene or Pliocene age, containing *Marginopora vertebralis*).

Little Bluff. *Nos.* $\frac{1}{41355}$ (1–2).
(Yellowish spicular rock).

III.—DESCRIPTION OF NEW AND RARE SPECIES.

PLANTAE.

Series CONIFERALES.

Genus AGATHIS Salisbury, 1807.

(*Dammara* Lamb : 1786, is a genus excluded from the Australian flora).

Agathis cf *Intermedia* (Ettingshausen).

Dammara intermedia, Ettingshausen, 1888, p. 98, pl. VIII, figs. 34–38. Deane, 1925, p. 495, pl. LXI, fig. 5 ; pl. LXIII, figs. 12, 15.

Observations.—A leaf-fragment, referable to the above genus of conifers, occurs on a slab of fine siliceous mudstone, associated with *Bombax.* and

1. The affinities of leaves of Australian examples referred to this genus have been questioned by the late Henry Deane, F.L.S., in conversation with the present writer. Deane was inclined to ascribe such foliage to *Kennedya* or an allied genus.

marine shells. The shape of the fragment indicates a long-ovate type with distinct parallel venation and measures 30mm. in length. The completed lamina might measure 10mm. across. This may be compared with *D. intermedia*, a species that Henry Deane identified in the Miocene leaf-bearing seams of the Brown Coal deposits at Yallourn, near Morwell, Victoria.

Occurrence.—Cape Riche, Albany district, W. Australia (Simpson collection).

Nat. Order FAGACEAE.

Genus NOTHOFAGUS Blume 1850.

Nothofagus Wilkinsoni (Ettingshausen).

Fagus Wilkinsoni Ettingshausen, 1888, p. 32, pl. II, fig. 1, 1A.

Observations.—Ettingshausen has noted that of the three Australian species of *Nothofagus*, ("*Fagus*") *N. Moorei* approaches most nearly to the above fossil species, both in the form and simple dentation, with secondary veins ending at denticles. The length of the incomplete lamina is 34mm., but when entire probably measured about 85mm. It has a width of 40mm., and with an average space between the secondary veins of 6mm. It agrees with Ettingshausen's figures. Associated with this leaf is a mould of the estuarine gasteropod genus *Potamides*. belonging to a species named in MS. by the late John Dennant, and now in the Dennant Collection at the National Museum. We now describe this (see *infra*) under Dennant's cheironym of "*Potamides nullarboricum*." From its previous occurrence at Aldinga Bay and the Nullarbor Plains it helps to fix the age of the Cape Riche beds.

Occurrence.—In the fine siliceous mudstones of Cape Riche (Simpson collection).

Nat. Order MALVACEAE.

Genus BOMBAX Linné, 1753 (1.).

Bombax Sturtii Ettingshausen, Pl. VI., fig. 1.

Bombax Sturtii Ettingshausen, 1888, p. 60, pl. VI, fig. 1. Tate and Watt, 1896, p. 67.

Observations.—A fine and nearly complete example of this form of leaf found associated with marine shell impressions on the same slab, is comparable with Ettingshausen's fig. 1. The lanceolate shape with ovately curving sides, the strong midrib and the gently and evenly curving secondary ribs at about 35° to the former, confirms this determination. *B. Sturtii* has been previously recorded from Dalton, near Gunning, N.S. Wales, and from Elizabeth River, West of Lakes Eyre and Torrens, S. Australia.

Occurrence.—Cape Riche. (Simpson collection).

Bombax Mitchelli Ettingshausen.

Bombax Mitchelli Ettingshausen, 1888, p. 61, pl. VI., fig. 2

Observations.—The present specimen represents a broader type of leaf than that of the foregoing species, and it has the secondary veins emerging from the midrib at a wider angle. More than half the leaf is preserved, as an impression, which can be closely compared with Ettingshausen's fig. 2 (*loc. cit.*), which came from Dalton, N.S. Wales.

Occurrence.—Cape Riche. (Glauert Collection, No. 277.).

ANIMALA.

PHYLUM PROTOZOA.

Order FORAMINIFERIA.

Family PENEROPLIDAE.

Genus MARGINOPORA Quoy & Gaimard.

Marginopora vertebralis, Q. & G.

Observations.—The examples from the Balladonia limestone occur in a hard grey limestone which is evidently a slightly different phase from the ordinary pink limestone of the same collection. It seems that there is no doubt that it belongs to the same age as the other specimen for it has already been recorded from limestones as old as this from the Ooldea District, South Australia (Chapman, 1920. P. 232). Although this is an exceptionally large specimen measuring 1 inch in diameter, it is eclipsed by that from Ooldea which reached $1\frac{1}{2}$ inches.

Occurrence.—Balladonia limestone. Eucla District. (No. 3263).

Phylum **PARAZOA** (Spongiae).

Class **SILICISPONGIAE.**

Order MONACTINELLIDA.

Family TETHYIDAE.

Genus TETHYA Lamarck.

Tethya aff. *Robusta* Bowerbank.

Hinde, 1910, p. 15, pl. 11, fig. 18.

Observations.—Globostellate spicules from Norseman resembled those from the above species, still living in Australian seas.

Occurrence.—Norseman (G. J. Hinde).

Fam. SPIRASTRELLIDAE.

Genus LATRUNCULIA Bocage

Latrunculia sp.

Hinde, 1910, p. 11, 12. pl. 1. fig. 17, 18, 20, 21.

Observations.—Hinde records *Sceptrella* or chessmen flesh spicules, referable to this genus.

Occurrence.—Norseman (G. J. Hinde).

Fam. HAPLOSCLERIDAE.

Genus HALICHONDRIA Fleming.

Halichondria sp.

Hinde, 1910, p. 10, pl. 1. f. 7.

Observations.—Hinde compares acerate spicules from Norseman with similar forms from Oamaru, New Zealand, and also with the recent *Halichrondria infrequens*, Carter, from the Gulf of Manaar.

Occurrence.—Norseman (G. J. Hinde).

Genus PETROSIA Vosmaer.

Petrosia cf. *Variabilis* Ridley.

Hinde, 1910, p. 10, pl. 1, f. 3.

Observations.—Fusiform acerate spicules, recorded by Hinde.

Occurrence.—Norseman (G. J. Hinde).

Fam. DESMACIDONIDAE.

Genus DESMACIDON Bowerbank

Desmacidon (*Homoeodictya*) *gradnis* Ridley and Dendy.

Hinde, 1910, p. 10. pl. 1. f. 2.

Observations.—Fusiform acerate spicules compared by Hinde with those of the living sponge from Simon's Bay, Cape of Good Hope.

Occurrence.—Norseman (G. J. Hinde).

Genus FORCEPIA Carter.

Forcepia cf. *Crassanchorata* Carter.

Hinde, 1910, p. 11. pl. 1. f. 15.

Observations.—Spicules compared by Hinde to the living *F. crassanchorata* from Pt. Elliot, South Australia.

Occurrence.—Norseman (G. J. Hinde).

Fam. HAPLOSCLERIDAE.

Genus STRONGYLOPHORA Dendy

Strongylophora, sp.

Hinde, 1910, p. 11, pl. 1. f. 8, 9.

Observations.—The Norseman material described by Dr. Hinde contains, according to that author, " slightly curved cylindrical spicules, smooth, with ends evenly rounded." He compares the spicules with those seen in *Strongylophora durissima* Dendy, from the Gulf of Manaar.

Occurrence.—Norseman (G. J. Hinde).

Order TETRACTINELLIDA.

Fam. TETILLIDAE.

Genus CRANIELLA O. Schmidt.

Craniella, sp.

Hinde, 1910, p. 14. pl. 11. f. 3.

Observations.—Trifid spicules with simple head-rays directed upwards, were found by Hinde, who compared them with the above genus or *Stelletta*.

Occurrence.—Norseman (G. J. Hinde).

Fam. STELLETTIIDAE.

Genus STELLETTA Oscar Schmidt.

cf. *Stelletta reticulata*, Carter.

Hinde, 1910, p. 13. pl. 1. f. 32.

Observations.—A trifid spicule, with simple slightly curved and nearly horizontal head-rays has been compared with those of Carter's sp. from the South coast of Australia.

Occurrence.—Norseman (G. J. Hinde).

Genus ECIONEMA, Bowerbank.

Ecionema glauerti, sp. nov.

Plate VI., fig. 2.

Description of Holotype.—

The body of the sponge is of a slender cylindrical form, slightly curved, and apparently attached by an irregular, swollen base. The interpenetrating canals are numerously disposed over the weathered surface, whilst the long slightly curved acerate oxea average in length 3·5mm. These principal skeletal spicules give a fibrous and woody appearance to the fossil. Microrhabds numerous, slightly curved, with rounded ends or finely acerate. Other of the microscleres (smaller spicules) include sanidasters, which are irregularly rod-shaped and with a spiny surface, as well as numerous sub-spherical sphaerasters with short thorny processes. Occasionally the oxea are smooth or sparsely pitted.

Spicules of the protriæne type are common in the basal part of the sponge. Length of produced rhabdus 1·48mm. Length of cladi, 0·58mm., forming an angle of about 20° with the produced rhabdus.

The solidly spicular structure precludes this fossil body from being a cloacal tube. Length of sponge body, 44mm. ; average diameter of cylindrical portion, 6mm.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, H5. Holotype).

Fam. GEODIIDAE.

Genus EYRLUS Gray

Erylus, sp.

Hinde, 1910, p. 14. pl. 11. f. 2.

Observations.—Trifid spicules with a straight elongate shaft and with each of the head-rays bifurcated and horizontally extended are compared by Dr. Hinde with the Eocene genus *Erylus* Gray.

Occurrence.—Norseman (G. J. Hinde).

Genus CAMINUS O. Schmidt.

Caminus parvistoma, sp. nov.

Plate VI., fig. 3.

Description of Holotype.—Sponge massive and spreading, roundly lobulate, attached. Ossules small as compared with *C. sphæroconia* Sollas (1888, p. 214, pl. XXVII), situated at the summit of the lobes, with openings re-entrant and sharply rimmed ; narrow incurrent canals leading into the oscules.

Incurrent pores conspicuously rimmed, situated in sieve structure, and revealed on worn surface as oblique channels.

Spicules.—Orthotriæne, with long stout axis and double divergent cladi ; axis 1·8mm. in length. Numerous curved fusiform microrhabds are also present measuring 0·73mm. in length. Besides these are occasional spicules which are usually seen in *Cydonium*, namely globostellate and knobby forms, together with some trifid and nodulose spicules like those figured by Hinde (1910, pl. 11. f. 7, 8.) as " skeleton spicules of *Ragadinia*," a lithistid form.

Observations.—Triæne spicules with bifurcated head-rays such as seen in *Caminus parvistoma* were also noted by Hinde (1910, pl. 11, f. 2.) who, however, referred them to *Erylus*.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection $\frac{1}{3967}$, Holotype).

Caminus nitidus, sp. nov.

Plate VI., fig. 4.

Description of Holotype.—Sponge hemispherical, free or only slightly attached to extraneous objects. Oscules few, as sub-circular shallow cavities (circ. 8mm. in diameter), with fine grooves radiating from the interior. Pores rounded, numerous, having a diameter of circ. 2mm. Skeletal structure as in the preceding species but of a finer or closer texture.

Dimensions.—Holotype : diameter 33mm. ; height 22mm.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, $\frac{1}{3988}$ Holotype).

Genus CYDONIUM Fleming.

Cydonium mulleri Fleming.

Geodia aff. *zetlandica* Johnston.

Hinde, 1910, p. 14, pl. 11, f. 6.

Observations.—Trifid spicules of this or an allied genus are recorded by Hinde from the Norseman deposit.

Occurrence.—Norseman (G. J. Hinde).

Cydonium ramuliferum, sp. nov.

Plate VI., fig. 5.

Description of Holotype.—Sponge cylindrical, sometimes flattened or tuberous, occurring in fasciculated masses. Individual branches measuring about 5cm. in length and about 1cm. in breadth. Preserved in a limonitic matrix, but still having the siliceous web preserved in part. The skeletal spicules are orthotriænes, and also large and small microrhabs. The latter are gently arcuate, fusiform and smooth, and usually with an axial canal ; they measure 0·18mm. in length.

Observations.—The grapnel spicules mentioned by Hinde (*loc. cit.* p. 14), as probably referable to the preceding form, *Cydonium* aff. *mulleri* were not seen in the present species.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, $\frac{1}{3973}$, Holotype).

Order LITHISTIDA.

Fam. TETRACLADIIDAE.

Genus THEONELLA Gray.

cf. *Theonella swinhoei* Gray.

Hinde, 1910, p. 18. pl. 111. f. 2.

Observations.—Dr. Hinde has compared a dermal spicule having a short shaft and five horizontally extended rays, with that of the living sponge cited above, from Manila and Formosa.

Occurrence.—Norseman (G. J. Hinde).

Genus DISCODERMIA Bocage

Discodermia gigantea, sp. nov.

Pl. VII., fig. 6.

Description of Holotype.—This sponge is of very large size and compared with the known living forms. It is irregularly lobose, forming apparently a compound colony, the soma of which resembles depressed domes or lobes.

The process of petrifaction, so far as one can see, has resulted in the destruction of the ectosome, although in the surrounding mud are fragments of what may be dermal spicules, We have been unable, however, to find definite spicules like those figured by Dr. Hinde from the Norseman rock, which he has referred to the genus *Discodermia*. In the present specimen there is no sign of a pedicle, the base being flattened on the seat of attachment. The The worn condition of this sponge shows the pores very clearly. The ostia have an average diameter of 2mm. The pores are minute and scattered over the surface, measuring about 0·5mm. The ostia have a general radial arrangement from the centre of the base.

Structure of the Skeleton.—The body of the sponge has become opalized and solidified, but much of the skeletal structure is shown with its original porous character. The main skeletal mesh consists of more or less elongated tetracrepid desmas. Near the exterior of the skeleton there are numerous oxeas both straight and curved, averaging about 1·5mm. in length. Those spicules of the tetracrepid type closely resemble the skeleton spicules of *Discodermia* sp. figured by Dr. Hinde (1910, pl. 11. figs. 9, 10.), but in many cases they are much larger and more elongate in form.

Dimensions.—Greatest width, 27·5cm. ; Greatest height, 12·5cm.

Observations.—As to the form of this sponge the comparison may be made with the species described by Professor Sollas from Port Jackson, N.S.W., as *Discodermia discifurca*. The living species is about one third the diameter of the fossil. It also shows the mode of attachment by a flattened base rather than a pedicle. The cup-shaped habit of this species makes it different from the above fossil species in which there is very little evidence of cloacal cavities.

The tetracrepid desma of the living *D. discifurca* are much slenderer than those of the present fossil species, *D. gigantea*.

Occurrence.—Albany, W.A. (E. S. Simpson collection).

Discodermia tabelliformis, sp. nov.

Pl. VII., figs. 7, 8.

Description of Holotype.—Sponge massive, complanate, surface mamillated, with dense texture ; where abraded finely porous. Beneath the surface crust the sponge is closely perforated with fine vertical and sinuous pores. Skeletal spicules are of the type characteristic of the above genus, and are furcate, twisted and covered with small tubercles.

Microscleres, slender curved or bow-shaped oxea, 0·18mm. in length, and elongate-ovate microstrongyles, 0·045mm. in length.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, $\frac{1}{3966}$. Holotype).

Discodermia retepora, sp. nov.

Pl. VII., fig. 9.

Description of Holotype.—Massive, of a compressed, more or less tabulate form, with an undulose surface. Pores large (circ. 3mm. in diameter). Skeletal mesh formed of strongyles with rounded centres and radiating cladi, the globular nuclei giving a finely beaded aspect to the desma.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection. $\frac{1}{3964}$. Holotype). A fairly abundant species.

Discodermia tumulosa, sp. nov.

Pl. VIII., fig. 10.

Description of Holotype.—Form of sponge, depressed to sub-globular, with surface rising into mamillated prominences. Ostia distinct, small (circ. 0·75mm. in diameter) and numerous.

Observations.—The skeleton resembles in many respects that of a typical living *Discodermia*, but in this variable species the ostia although small, are very distinct from the finer incurrent pores. *D. tumulosa* varies from the slightly mamillate to the coarsely globulose form. It is one of the more abundant species in this collection.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, $\frac{1}{3903}$. Holotype).

Genus NEOSIPHONIA Sollas

Neosiphonia fungiformis, sp. nov.

Pl. VIII., figs. 11, 12 ; Pl. IX., fig. 13.

Description of Holotype.—The form of this sponge is somewhat depressed mushroom-shaped, with a rather expanded head and thickened pedicle, the latter being marked off from the main body of the sponge by a distinct but irregularly excavated sulcus on the under surface of the capitulum. In general outline the sponge is sub-pyriform and much depressed at the summit. The sides of the sponge are marked with a series of vertical fissures which commence at the base of the pedicle and pass over the periphery at the top, where they are lost in the central cloacal area at the summit. This central area at the top of the sponge occupies about half the entire diameter, and is covered with a large number of crowded tubular oscula which belong to the excurrent system. The sides of the sponge are also divided by a series of irregular, more or less horizontal, fissures which appear to be partly induced by shrinkage.

The basal view of the sponge shows a general radial structure, in which the skeleton is grouped along certain lines due to the close inter-growth or zygosis of the spicules of the desma. The diameter of the oscula have an average measurement of 1·25 mm.

Dimensions.—Greatest height, 51mm. Greatest width, 65mm.

Structure of the Skeleton.—The holotype described above is finely preserved and the skeletal mesh shows distinctly on the surface, Owing to fossilisation the spicules other than the megascleres seem to have been lost. The megascleres of the desma measure 0·94mm. in length, and 0·42mm. in width.

Observations.—The genus *Neosiphonia* was founded on a living species, *N. superstes*, dredged from a depth of 315 fathoms in coral mud off Matuka, Fiji Islands. It was collected during the voyage of the "Challenger" and described by Prof. W. J. Sollas (Sollas, 1888, p. 299–301, Pl. XXXII. figs. 7–12). In his remarks on the living specimen Prof. Sollas states that the sponge consisted merely of the skeleton with the exception of a few shreds of dermal material, and it was from this that he obtained the dermal spicules which in the present fossil example seem to be absent.

As Prof. Sollas has already remarked, this genus is extremely interesting from the fact that it appears to be a surviving representative of the common *Siphoniæ* and *Jereæ* of the Mesozoic formations and especially of the Chalk. The present species forms an important link between the living and the cretaceous species in point of age.

Occurrence.—Clay Pit, near Racecourse, Albany. W.A. Holotype (E. S. Simpson collection).

Also Hamersley River District, W.A. (W.A. Geol. Surv. collection paratype $\frac{1}{3984}$.) Variable forms, some examples being more fig-shaped than the type.

Neosiphonia glauerti, sp. nov.

Pl. IX., fig. 14.

Description of Holotype.—A funnel shaped sponge, conical, with a bluntly apical pedicle. Cloacal cavity wide, fairly deep, with gently concave sides. Numerous small oblique openings into the cloacal cavity (postica). Sides of sponge body having numerous small rounded pores (ostia). Skeletal mesh consisting of closely welded dichotriaenes. Surface, with dermal spicules, chiefly microxeas and microrhabds.

Dimensions.—Height of sponge, 53mm. ; greatest diameter across cavity at summit, 42mm.

Occurrence.—Hamersley River District, (W.A. Geol. Surv. collection $\frac{1}{3991}$. Holotype).

Genus THECOSIPHONIA Zittel

Thecosiphonia lobosa, sp. nov.

Pl. IX., fig. 15.

Description of Holotype.—Sponge, irregularly lobose, constricted medially in the holotype ; varying in slope to depressed conical. Dermal layer consisting of small clasping rhabdocrepid desma, as in the living *Pleroma.* The skeletal portion consisting of a coarse mesh of nodular spicules with smooth divergent arms.

Several cloacal openings occur on the summit of the sponge, as wide shallow depressions, perforated by excurrent canals having a diameter of about 3 to 4 mm. Incurrent canal openings numerous ; apertures circular to ovoid, 1mm. in diameter.

Observations.—Both in general form and skeletal structure this Tertiary sponge resembles the well-known cretaceous genus with its typical species *T. turbinator* Hinde, from the Upper Chalk of Wiltshire, England.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, Holotype $\frac{1}{3969}$).

Genus THAMNOSPONGIA Hinde

Thamnospongia neoclavellata, sp. nov.

Pl. IX., fig. 16.

Description of Holotype.—Sponge : sub-cylindrical, rather lobose and wrinkled, Surface covered with a dermal layer ; bearing short blunt arms (eight in type), which are generally broken, thus revealing the coarser pores (ostia) of the inner skeletal structure. The desmas are tetracvepid and form a close mesh-work of the endoskeleton, perforated by fine, rounded pores. Amongst the spicules of the dermal layer were noticed spirasters and microxea.

Dimensions.—Length of holotype, 50mm. ; greatest width, 20mm.

Observations.—In general form, as well as in structure, the above species closely approaches *Thamnospongia clavellata* (Benett) from the Upper Chalk of Wiltshire (Hinde, 1883, p. 79, pl. XVIII. f. 2, 2*a*, *b*).

Occurrence.—Moderately common. Hamersley River District, W.A. (W.A. Geol. Surv. collection, Holotype $\frac{H}{19}$).

Thamnospongia subglabra, sp. nov.

Pl. IX., figs. 17, 18 ; Pl. X., fig. 19.

Description of Holotype.—Holotype sub-cylindrical, with verrucose or pustulate surface. Paratype more or less compressed cylindrical, with two branches. Surface moderately smooth to even, covered with fine pores. Indication of cloacal tube at end of branches.

Dimensions.—Length of holotype, 75mm. ; greatest thickness, 20mm. Length of paratype 52mm.

Observation.—The numerous examples in the Glauert collection do not show any dermal layer. The porous character of the skeletal mesh is finer, whilst the ostia are smaller than usual.

Comparison is suggested with *Thamnospongia glabra* Hinde (Hinde 1883 p. 79. pl. XVII. f. 5 and 5*a–c*). This latter species is found in the Upper Chalk of Bechampton, Wiltshire, England. Its bushy manner of growth indicates that the present Tertiary species had a similar habit and that the fossil remains in this collection are the separated branches of the ramose sponge body.

Occurrence.—Hamersley River District W.A. (W.A. Geol. Surv. collection. Holotype $\frac{H}{1}$; Paratype $\frac{H}{16}$).

Genus RAGADINIA Zittel

Ragadinia placentiformis, sp. nov.

Pl. X., fig. 20.

Description of Holotype.—Sponge, when complete, platter-shaped, with an undulose surface. Layers of expansive growth marked by concentric, curved grooves. Skeletal mesh formed of tuberculate strongyles, closely fused. Abundant microrhabds seen on disintegrating the tissue ; these are slightly curved, cylindrical, smooth and generally roundly ended ; they average 0·34mm. in diameter.

Dimensions.—Greatest diameter of specimen, 10cm. Thickness of cup, circ. 7mm. Diameter of complete cup, circ. 12cm.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, Holotype $\frac{1}{3981}$).

Fam CORALLISTIDAE

Genus CORALLISTES O. Schmidt.

? Corallistes sp.

Observations.—A dermal spicule with a short shaft and six horizontally extended rays has been figured by Dr. Hinde (Hinde, 1910, p, 17. pl. III. f. 1.) as referable to *Corallistes* or another genus.

Occurrence.—Norseman (G. J. Hinde).

Fam. ANOMOCLADIIDAE.

Genus VETULINA O. Schmidt.

Vetulina sp.

Observations.—" A spicule with four or five rays extending in different directions from a definitely thickened centre " is figured by Dr. Hinde (1910, p. 18. pl. II. fig. 11) who compares it with similar spicules from the Miocene of Oamaru, New Zealand.

Occurrence.—Norseman (G. J. Hinde).

Genus PLATYCHONIA Zittel.

Platychonia tertiaria, sp. nov.

Pl. X., fig. 21.

Description of Holotype.—Body of sponge complanate, encrusting, with external surface undulate and cuspid at edges. The upper weathered surface shows a well defined system of cloacal pores radiating outwardly from the base. Skeleton on weathered surface seen as a closely welded mass of globular spicules (megascleres), with 4 to 7 or more radiating arms. Microscleres represented by short oxea and microstrongyles like those seen in the living genus *Azorica*.

Observations.—This is an interesting link with the Liassic and Jurassic sponges of Europe, belonging to the same genus.

Occurrence.—Hamersley River District, W.A. (W.A. Geol. Surv. collection, Holotype $\frac{1}{3990}$).

Genus VERRUCULINA Zittel.

Verruculina albanyensis, sp. nov.

Pl. XI., fig. 22.

Description of Holotype.—Sponge (preserved in limonite), funnel-shaped, compressed. Dermal surface showing minute pores, and where worn away the ostia radiating from the base to the rim. Internal face of cup with fine pores and scattered ostia, the orifices of which are surrounded by raised rims.

The megascleres in the skeletal tissue of this fossil are seen to be similar to those figured by Dr. Hinde, from *Verruculina seriatopora* (Reuss), from the Upper Chalk of Sudmerberg (Hinde 1883, p. 36. pl. III. f. 4).

Dimensions.—Height of cup, 56mm. ; approximate breadth at opening, 64mm. ; narrow diameter of cup, 32mm. Width of ostia, 1·75mm.

Occurrence.—Hill, 1 mile from Warring Homestead, Albany, W.A. (Glauert collection ; Holotype $\frac{1}{4134}$).

Class **HEXACTINELLIDA.**

Fam. ROSSELLIDAE.

Genus ROSSELLA Carter.

Rossella aff *Antarctica* Carter.

Rossella sp.

Hinde, 1910, pp. 19, 20. pl. III. f. 12–14.

Observations.—Dermal umbrella spicules figured by Hinde from the Norseman material are compared by him to those seen in *Rossella antarctica* Carter, but differing in being smaller and in having a patagium connecting the rays, as seen in various Cretaceous species.

Occurrence.—Norseman (G. J. Hinde).

Fam. MAEANDROSPONGIDAE.

Genus DACTYLOCALYX Stutchbury.

Dactylocalyx simpsoni, sp. nov.

Pl. XI, fig. 23.

Description of Holotype.—The actual form of the sponge is somewhat doubtful since only the branching portions remain. It may have been of a

low compact funnel-shape when complete, but is now represented by two main portions which show a characteristic canal system of which the tubes measure from 1·5mm. in diameter. The body of this sponge when complete probably had a diameter of 4·5cm. Only the internal mesh work of the sponge remains, but it shows such close resemblance with that of *Dactylocalyx patella*, Schulze, as to make the comparision at least generic (Schulze, F.E. 1887, p. 350. pl. C.). The tubes of the sponge body are smaller than that of the living species. They appear in some instances to run parallel for some distance and then to divaricate. The natural surface of the sponge is wanting, apparently being lost by partial decompositions in the matrix. The framework of the sponge in the main portion shows square meshes more or less regular, and especially in those portions nearest the walls of the tubes where in transverse section they seem to form a concentric structure. Portions of the dictyoninal skeleton in the neighbourhood of the canals are seen to carry sharp conical bosses which project radially into the lumen of the canals. These conical projections of the skeletal mesh are beset with fine pointed tubercles, as in the recent species which was dredged off the coast of Portugal and S.W. of the Bermudas from a depth of 1,075 fathoms by the Challenger.

Occurrence.—Albany, W.A. (E. S. Simpson collection).

Class **ECHINOIDEA.**

Order CIDAROIDA.

Fam. CIDARIDAE.

Genus PHYLLACANTHUS Brandt.

cf. *Phyllacanthus* sp.

Observations.—Impression of a cidaroid spine, the ornament of which represents that of the above genus.

Occurrence.—Albany. (Jutson collection).

Order SPATANGOIDEA.

Fam. SPATANGIDIEA.

Genus HEMIASTER Desor.

Hemiaster sp.

Observations.—The larger example, labelled No. 309 (1) from the Glauert collection, is a cast, much crushed, but still showing the high posterior vertex. As regards the characters of the ambulacral area, the anterior furrow is moderately deep, but not so constricted as in *Hemiaster planedeclivis*. Moreover the outline of the test (ambitus) is more circular than in that species.

The second and smaller specimen, No. 309 (2), has the ambulacral system closely comparable with Gregory's *Hemiaster planedeclivis*, but allowing for crushing the posterior vertex is not so high. The outline of the test of this form is more heart-shaped than the first specimen referred to. It agrees generally in character with a specimen from Waurn Ponds, Victoria, in the National Museum collection.

Occurrence.—Cape Riche, Albany District. (Glauert collection.)

Genus SCHIZASTER Agassiz.

Schizaster sp.

Observations.—In the Jutson collection there occur four specimens of an undescribed form referable to the above genus. They are all in form of casts, and are distorted in various ways by local crushing. There are two

additional specimens in the Glauert collection, Nos. 5718 and 405, from the same locality. Since the characters are wanting, which can be used in a specific sense on account of the absence of the test, the generic reference only is given. At the same time, it may be remarked, that from Table Cape and Torquay there appears to be an identical species, in the National Museum collection.

The features of the casts, taken *inter alia*, may be given as follows :— The test is more or less cordate ; the ambulacral furrows are deep, especially the anterior by which the ambitus is distinctly notched. The anterior lateral furrows are divergent at a high angle, whilst the posterior pair are much shorter and less strongly developed. The peristome is strongly lipped. The periproct is possibly transversely ovate.

Dimensions.—One of the least crushed specimens measures 48 mm. in ant-posterior direction and 41 mm. at right angles.

Occurrence.—Cape Riche (Glauert & Jutson collection).

Genus EUPATAGUS Agassiz

? *Eupatagus* sp.

Observations.—A cast of the test of a tumid ovoid shape with indications of a flush ambulacral system, may be referable to this genus.

Occurrence.—Cape Riche (Jutson collection).

Class **POLYZOA.**

Order CHEILOSTOMATA.

The following have been determined from material in the Simpson col lection from Norseman :—

Macropora clarkei (T. Wds.), Also in the Albany Beds (Simpson collection).

Acropora gracilis (M. Edws.).

Occurrence.—Norseman, in a silicified and partly opalised bed (Simpson collection).

In addition, Prof. J. W. Gregory (1916, p. 320–1) gives the following list from the same locality :—

Membranipora delicatula (Busk).
Cellaria rigida McG.
Schizoporella convexa McG. = *Lacerna convexa* (McG.).
Macropora clarkei (T. Wds.).
Schismopora modesta McG.

Class **BRACHIOPODA.**

Order TELOTREMATA.

Fam. TEREBRATULIDAE.

Genus TEREBRATULA Klein.

Terebratula aldingae Tate.

Observations.—A cast of this interesting species is comparable with those forms that are restricted to the Aldingan (South Australia) and Cape Otway (Victoria) series.

Occurrence.—Albany (Jutson collection).

Terebratula tateana T. Woods.

Observations.—A compressed cast is comparable with the above specie

Occurrence.—Albany (Jutson collection).

Fam TEREBRATELLIDAE.

Genus MAGELLANIA Bayle.

Magellania insolita Tate.

Observations.—A specimen collected by Dr. Simpson is a cast with part of the shell attached and replaced in silica embedded in the polyzoal rock of Norseman.

Occurrence.—Norseman (Simpson collection).

Magellania pectoralis (Tate).

Observations.—A fairly well-preserved cast of this species occurs in which the characters of the small foramen and the produced beak are well shown. It is interesting to note the previous restricted occurrence of this species, only at Aire Coast, Victoria, and Aldinga and Happy Valley, South Australia. This specimen has a total length of 56mm.

Occurrence.—Cape Riche (Glauert collection).

Class **PELECYPODA.**

Order PRIONDESMACEA.

Fam. ARCIDAE.

Genus ARCA Lam.

Sub-genus BARBATIA Gray.

Arca (*Barbatia*) cf. *consutilis* (Tate).

Observations.—The two examples of this species are represented by casts of the interior of the valve, in chert. The contour of these shells practically confirms the identity with the above species.

Occurrence.—Warriup Homestead, Albany, and Hassell's Homestead. (Glauert collection).

Arca sp.

Observations.—This fossil is an internal cast of a species having a strongly angulated umbonal ridge, and in general character appears to be related to both *A. celleporacea* and *A. simulans.*

Occurrence.—Albany (Jutson collection).

Genus GLYCYMERIS Da Costa

Glycymeris maccoyi (Johnston).

Observations.—Two examples occur both in the form of internal casts. In one specimen, from near Mt. Manypeak, the matrix shows the costation of the medium layer of the shell, possibly indicating partial solution during fossilisation of the internal layer of the original shell. The previous localities at which this species has occurred are Table Cape, Tasmania, and Ooldea (South Australia).

Occurrence.—Cape Riche (Jutson collection), and coast near Mt. Manypeak (Glauert collection).

Fam. PECTINIDAE.

Genus CHLAMYS Bolten.

Chlamys aldingensis (Tate).

Observations.—A cast of valve showing the characteristic disappearance of the costation towards this hinge line.

Occurrence.—Albany (Jutson collection).

Chlamys flindersi (Tate) sp.

Observations.—Internal cast of valve shows typical angulated rib of *C. flindersi*, the costae numbering about 32 and are practically smooth. It

is separated from *C. sturtianus* by less divergent type of rib, and from *C. aldingensis* by the few ribs and more divergent type of costation.

Occurrence.—Albany (Jutson collection).

Fam. DIMYIDAE.

Genus DIMYA Rouault.

Dimya dissimilis (Tate).

Observations.—A cast in the soft sponge bed of Albany shows the impression of the upper valve of *Dimya dissimilis*. This specimen was tentatively determined as cf. *Chama lamellifera* in our previous report (A.A.A.S., 1926).

Occurrence.—Albany (Jutson collection).

Fam. MYTILIDAE.

Genus LITHOPHAGUS Megerle.

Lithophagus sp.

Observations.—The above specimen is in the form of an ironstone cast. The nearest related species is *Lithophagus latecaudatus* Pritchard, from the Lower Miocene of Torquay, Victoria, but differs from that species in having a longer and more parallel-sided shell, and a sharper umbonal keel. Length of shell-cast, 56mm. Greatest width, circ. 21mm.

Order TELEODESMACEA.

Fam. LUCINIDAE.

Genus CODAKIA Scopoli.

Codakia planatella (Tate).

Observations.—Although in the form of casts, the specimen can be identified with the above species which has only been recorded from Table Cape, Tasmania, as *Lucina planatella*.

Occurrence.—Balladonia limestone, Eucla district (Glauert collection, Nos. 3253 to 3256).

Fam. CARDIIDAE.

Genus CARDIUM Linné.

Cardium arcaeformis, sp. nov.

Pl. XI., figs. 25, 26, 27.

Description.—Valve, subquadrata, ventral edge roundly narrowing towards the front, produced posteriorly and truncally angulate towards the posterior angle. A rounded posterior umbonal ridge apparent ; shell strongly inflated and with prominent umbones. Ornament consisting of 25 ribs. Riblets with a central crenulated ridge and two lateral ones. Intercostal spaces excavated, relieved with concentric growth-lines.

Dimensions.—Length of shell, 15mm. Height, 15·5mm. Depth of valve, 7mm.

Observations.—One of the nearest related forms appears to be *Cardium exasperatum* Reeve, from Swan River, W.A. In form *C. arcaeformis* differs in being inflated, in its greater height, more oblique and more decided umbonal slope.

Occurrence.—Albany (Glauert collection, No. 6048).

Genus HEMICARDIUM Cuvier.

Hemicardium sp. Pl. XI., fig. 24.

Observations.—The present example is a cast which has been slightly crushed, but showing the general form of the united valves, and also some of

the original ornament which consists of numerous, closely set and flattened radiating ribs. In the absence of shell characters only the relationship of this form can be pointed out. The nearest related species is *Hemicardium nivale* (Reeve) from the Island of Corrigidor, Philippines, which was dredged from coral sand at the depth of 8 fathoms.

Occurrence.—Cape Riche (Jutson collection).

Fam. MACTRIDAE.

Genus MACTRA Linne.

Mactra axiniformis (Tate).

Observations.—This species is represented by a cast showing the main characters of the interior of the valves. It is important to note that the only locality previously recorded for this species is Torquay, Victoria.

Occurrence.—Balladonia limestone, Eucla district (Glauert collection, No. 3250).

Class **GASTEROPODA.**

Order ASPIDOBRANCHIA.

Fam. PATELLIDAE.

Genus CELLANA Adams.

Cellana jutsoni sp. nov.

Pl. XI., fig. 28.

Description of Holotype.—This is based on a squeeze in plasticene, of a mould of the shell in fine spicular ooze. The shell is ovately oblong, moderately depressed and with a fairly sharp apex situated about one-third from the anterior margin. Seen edgewise, the curvature of the shell from the apex to the posterior margin is strongly convex. Anteriorly, there is a slight depression under the apex. The lateral slopes of the shell are depressed-convex resulting in an obscure ridge extending from the apex to the posterior margin of the shell. The median area of the shell surface is almost smooth and marked by occasional concentric growth-lines. Towards the margin is developed a series of thin and sharp costae, numbering about 46 in the entire circumference. Close to the margin of the external surface these costae are crossed by very fine concentric lines.

Dimensions.—Longest diameter, 19·5mm. ; shortest, 14·5mm. Height at apex, 3·25mm.

Observations.—*Cellana jutsoni* appears to be quite distinct from any of the Australian species living or fossil. In its generic characters it is referable to *Cellana*. A form which may be distantly related to it is the Kalimnan species, *Cellana hentyi* (Chapman & Gabriel, 1923, p. 23, pl. I., fig. 2), from the Lawer Pliocene of the Grange Burn, near Hamilton, Victoria. That species differs, however, in the stronger costation of the shell and its heavy build.

Occurrence.—Holotype, Albany (Jutson collection).

Order CTENOBRANCHIATA.

Fam. MATHILDIIDAE.

Genus MATHILDA Semper.

Mathilda pagoda, sp. nov.

Pl. XI., figs. 29, 30.

Description of Holotype.—Aldinga Bay (Dennant collection, National Museum, Melbourne). Shell turreted, somewhat twisted in axis of growth, whorls angulate, ornamented with 3 lirate nodules bands, the basal one

being much stronger than the other two and more distinctly beaded. This principal band is just above the suture line and gives a geniculate appearance to the whorl. Numerous strong threads vertically crossing the lirae and at the point of junction becoming thickened.

Dimensions.—Length of Holotype, minus brephic stage, 14 mm. Width at base, 6 mm.

Description of Paratypes.—(a) Aldinga Bay (from Dennant collection). Specimen showing the perfect apex consists of 5 whorls in the neanic stage and the typical embryonic protoconch, and the succeeding brephic whorl, which is smooth.

(b) (Jutson collection). A wax squeeze of a mould shows the original shell to have been of a much heavier and larger type than the two from Aldinga Bay. Length, circ. 27 mm. and circ. 11 mm. at base.

Observations.—In its generic characters *M. pogoda* resembles *M. decorata* Hedley, but differs specifically in the longer embryonic stage and in the distinctly angulate whorls. This form from Aldinga Bay was listed from Adelaide by Tate and Dennant (1896, p. 127), under the manuscript name of *Colina pagoda.*

Occurrence.—Holotype, Aldinga Bay, South Australia (Dennant collection, National Museum, Melbourne, Reg. No. 13676). Paratype: Albany (Jutson collection).

Fam. XENOPHORIDAE.

Genus XENOPHORA Fischer.

Xenophora cf. *Tatei* Harris.

Observations.—This example is equal in size to a large specimen in the National Museum referred to *Phorus tatei*, from the lowest beds of the River Murray Cliffs near Morgan.

Occurrence.—Brick Works, 3 miles N.E. Albany (Glauert collection).

Fam. CERITHIIDAE.

Genus POTAMIDES Brongn.

Potamides nullarboricum, sp. nov.

Pl. XI., figs. 31, 32, 33.

Description of Holotype.—(From the Dennant collection, National Museum, Melbourne). Shell turreted, 10 whorls, slightly inflated, depressed at the sutures, the completed shell having about 18 whorls, including 3 in protoconch. Surface of whorls ornamented with about 13 riblets moderately sharp and slightly curved, which increase in width at the junction with the suture, giving an impression of a sutural band. The surface of the shell is also ornamented with fine spiral striations which cross the ribs. Mouth of shell subquadrate, base terminating in a short canal.

Description of Paratypes.—One of these specimens from the Dennant collection (Pl. VI., fig. 32) has 9 costate whorls and a smooth protoconch with 3 turns. The second specimen from Cape Riche (Jutson collection) of which a figure of a wax impression is given, is a mould of the shell showing the surface ornament very well preserved.

Dimensions.—Length of holotype, imperfect, 33·5 mm. Greatest width at base of shell, 12 mm.

Observations.—The above species is fairly common in form of casts and moulds in the fine siliceous rock from Cape Riche. Since there was already examples showing the shell in the Dennant collection labelled with the manu-

script name, *Potamides nullarboricum* by Tate, the name has been retained for the present species.

Occurrence.—Holotype: Lower beds, Aldinga, South Australia (Dennant collection, National Museum, Reg. No. 13674). Paratype: (a) Aldinga (Dennant collection, Reg. No. 13675); (b) Cape Riche (Jutson collection).

Fam. STROMBIDAE.

Genus SERAPHS Montfort.

Seraphs sp.

Observations.—An identical form has been described by Harris (1897, p. 218) from the Tertiary of the Nullabor Plains, South Australia. He stated that it is closely allied to the European Eocene species, *S. fusiformis* (Lam.).

Occurrence.—Bremer Bay (Glauert collection).

Fam. CYMATIIDAE.

Genus CYMATIUM Bolton.

Cymatium cribrosum (Tate).

Observations.—This identification is founded on a well preserved mould which shows characteristic lirate ornament showing the two strong bands on the shoulder of the whorls; also the attenuated spire terminating in $2\frac{1}{2}$ rounded whorls. This species has hitherto been recorded by Tate from the clayey greensands of the Adelaide Bore, whilst there are numerous specimens in the Dennant collection, National Museum, Melbourne, from Cape Otway, Victoria.

Occurrence.—Albany (Jutson collection).

Fam. FUSINIDAE.

Genus FUSINUS.

Fusinus simulans (Tate).

Observations.—This form ranged from the Upper Oligocene to the Middle Miocene in Victoria.

Occurrence.—Albany (Jutson collection).

Fusinus senticosus (Tate).

Observations.—This species, of which moulds are here found, have a range from Upper Oligocene to Middle Miocene in Victoria. In South Australia it occurs in the Middle Miocene, in Tasmania in the Lower Miocene of Table Cape.

Occurrence.—Albany (Jutson collection).

Genus SIPHONALIA Adams.

Siphonalia tatei (Cossman).

Observations.—Well preserved moulds of this species, which ranges from Upper Oligocene and Middle Miocene, were found in the spicule-bearing rock.

Occurrence.—Albany (Juntson collection).

Fam. VOLUTIDAE.

Genus VOLUTA Linné.

Voluta sp.

Observations.—A somewhat crushed cast of a large volute which bears a close resemblance to *V. atkinsoni*, Table Cape, Victoria.

Occurrence.—Brick Works, 3 miles N.E. of Albany (Glauert collection).

Genus SCAPHELLA Swainson.

Scaphella pagodoides (Tate).

Observations.—This form is characteristic of the Lower Miocene, both in South Australia and Victoria.

Occurrence.—Albany (Jutson collection).

Fam. OLIVIDAE.

Genus OLIVELLA Swainson.

Olivella angustata (Tate).

Observations.—This species, here represented by moulds, has hitherto been restricted to the Lower Miocene of Muddy Creek, Victoria.

Occurrence.—Albany (Jutson collection).

Fam. CONIDAE.

Genus CONUS Linné.

Conus dennanti (Tate).

Observations.—This form ranges from the Oligocene to the Lower Miocene of Victoria. The present specimen is a distorted cast, but quite specifically identifiable.

Occurrence.—Brick Works, 3 miles N.E. of Albany (Glauert collection).

Class **CEPHALOPODA.**

Order NAUTILOIDEA.

Fam. CLYDONAUTILIDAE.

Genus ATURIA Bronn.

Aturia australis (McCoy).

Observations.—This specimen is a partial cast of the shell, representing about two-thirds of the contour. An *Aturia* from Albany was described in detail some years ago by R. Bullen Newton (Newton, 1919), and was ascribed by that author to *A. aturi* (Basterot).

Occurrence.—Brick Works, 3 miles N.E. of Albany (Glauert collection)

Fam. NAUTILIDAE.

Genus NAUTILUS Linné.

Nautilus geelongensis (Foord).

Observations.—The two specimens from the Jutson collection are in the form of casts, and from the contour in the oral aspect appear to be referable to this species.

Occurrence.—Albany (Jutson collection).

Location of Types.

All those types belonging to the W.A. Geological Survey collection have been returned to Perth. Those from the Jutson collection have been presented by J. T. Jutson to the National Museum, Melbourne.

IV.—AGE OF BEDS AND SUMMARY.

(1) The important and in many ways unique sedimentary formation in the southern part of Western Australia, named the Plantagenet Series, by Jutson and Simpson, occurs in depressions laid down on a granite platform.

(2) The remarkable variation in the kinds of sedimentation of these Tertiary beds gives the Plantagenet Series an additional interest, for they comprise a rich sponge fauna, besides an accumulation of spicular muds, containing casts and moulds of mollusca and echinoids together with a fair number of well preserved leaves that have been carried down into these marine sediments.

(3) With regard to the age of the Plantagenet Series, the evidence of the mollusca is the most weighty, since the sponges, although numerous, represent a facies which is almost unique in our fossil beds, and which also contain more archiac genera than are usually found in beds of this age in any part of the world. Some of these fossil genera date back to the Jurassic and Cretaceous in Europe, whilst in other cases there are forms linking up the Cretaceous in Europe with the sponge beds being laid down at the present time, notably in the case of *Neosiphonia.*

(4) Certain of the fossil leaves here recorded had been previously met with through the work of the Horn Expedition to Central South Australia, which at the time were thought to be of Cretaceous age, but which are now accepted as Miocene.

(5) In 1915, J. T. Jutson and E. S. Simpson, had written that they believed that the beds would be ultimately determined as of Miocene Age. This statement was not published until two years later. In 1916, J. W. Gregory and A. E. Kitson, determined the age of the beds as Miocene, on the polyzoa and mollusca. In 1926, after a preliminary examination, the present authors expressed their view that the fauna showed an age about the Middle Miocene and a connection with that of Table Cape, Tasmania and South Australia.

(6) The present detailed study shows that from the mollusca alone, the age of this Plantaganet Series can be definitely stated as of Lower Miocene age. Since writing our preliminary paper now we have obtained proof of a slightly greater antiquity of the lower beds at Table Cape, for they in turn, can be linked up with those of Torquay in Victoria, also definitely Lower Miocene.

COMPLETE LIST OF FOSSILS COMPRISED IN THE PLANTAGENET SERIES.

Abbreviations used in regard to localities :—

A = Albany ; B = Balladonia limestone ; H = Hamersley River ; R = Cape Riche ; BW = Brick Works, 3 miles N.E. of Albany ; SC = Sugar Bag Creek ; W = Warriup Homestead ; WH = Hill, 1 mile from Warriup Homestead ; LB = Little Bluff ; HH = Hassell's Homestead ; M = Mt. Manypeak ; BB = Bremer Bay ; HR = Hassell's Road ; C = Near Cheyne Beach ; K = King River ; N = Norseman.

Plantae :

Agathis cf. intermedia Ett.	R
Nothofagus wilkinsoni Ett.	R
Bombax mitchelli Ett.	R
,, sturtii Ett.	R
cf. Grevillea	A

Foraminifera :

Marginopora vertebralis, Q. & G.	B

Spongida :

Tethyia aff. robusta Bowerbank	N
Latrunculia sp.	N
Halichondria sp.	N
Petrosa cf. variabilis Ridley	N
Desmacidon (Homoeodictya) grandia Ridley & Dendy	N
Forcepia cf. crassanchorata Carter	N
Strongylophora sp.	N
Craniella sp.	N
cf. Stelletta reticulata Carter	N
Ecionema glauert sp. nov.	H
Erylus sp.	N
Caminus parvistoma sp. nov.	H
,, nitidus sp. nov.	H
Cydonium mulleri Fleming	N. & H.
,, ramuliferum sp. nov.	H
Discodermia gigantea sp. nov.	A
,, tabelliformis sp. nov.	H
,, retepora sp. nov.	H
,, tumulosa sp. nov.	H
Neosiphonia fungiformis sp. nov.	H. & A.
,, glauerti sp. nov	H
Theonella swinhoei Gray	A
Thecosiphonia lobosa sp. nov.	H
Thamnospongia neoclavellata sp. nov.	H
Thomnospongia subglabra sp. nov.	H
Ragadinia placentiformis sp. nov.	H
? Corallistes sp.	N
Vetulina sp.	N
Platychonia tertiaria sp. nov.	H
Verruculina albanyensis sp. nov.	W
Rossella aff. antarctica Carter	N
Dactylocalyx simpsoni sp. nov.	A
Sponge spicules, indeterminate	LB
Spicules in chert	SC

Echinoidea :

Phyllacanthus sp.	A
Hemiaster sp.	R
Schizaster sp.	R
? Eupatagus sp.	A

Polyzoa :

Cellaria rigida McG	N
Membranipoda delicatula (Busk)	N
Macropora clarkei (T. Wds.)	N
Schismopora modesta McG.	N
Lacerna convexa (McG.)	N
Acropora gracilis (M. Edws.)	N
Lepralia sp.	R
Schizellozoon sp.	C

Brachiopoda :

Terebratulina aldingae Tate	A
Terebratula tateana T. Wds.	A
Magellania insolita (Tate)	N
,, pectoralis (Tate)	R
,, cf. sufflata (Tate)	B
? Magellania sp.	A

Pelecypoda :

Nucula obliqua Lam.	R
Cucullaea corioensis McG.	R
Limopsis sp.	R

Pelecypoda—continued.

Arca (Barbatia) cf. cainozoica Tate	A
,, ,, sp.	HH. A. & W
,, ,, cf. consutilis Tate	HH. & W.
Glycymeris maccoyi (Johnston)	M. & R.
Pteria (Meleagrina) crassicardia Tate	R
Hinnites sp.	HH
Chlamys aldingensis (Tate)	A
,, flindersi (Tate)	A
,, eyrei (Tate)	A
,, murrayana (Tate)	R
,, praecursor (Chapm.)	B
,, sturtianus (Tate)	R
Dimya dissimilis Tate	A
Lima bassi T. Wds.	N
Lithophagus sp.	K
Crassatellites ? sulcatus Sol.	BB
Venericardia spinulosa (Tate)	N
,, scabrosa (Tate)	A., W. & SC
,, cf. scabrosa (Tate)	N
,, cf. delicatula (Tate)	SC
,, cf. gracilicostata (Tate)	W
Codakia planatella (Tate)	B
cf. Diplodonta sp.	BB
? Dosinia johnstoni Tate	HH
cf. Dosinia sp.	BB
Cardium arcaeformis sp. nov.	A
,, aff. cuculloides Tate	A. & B.
,, cf. pseudomagnum McCoy	B
Hemicardium sp.	R
Callanaitis cainozoicus (Tate)	HR. & B.
? Callanaitis sp.	W
Clausinella allporti (T. Wds.)	R
cf. Clausinella sp.	R
Katelysia sp.	R
Antigona cf. hormophora (Tate)—	K
Meretrix sp.	R
cf. Meretrix sp.	B
Tellina sp.	K
Mactra axiniformis Tate	B
Corbula sp.	N
Kuphus sp.	B

Gasteropoda :

Cellana justoni sp. nov.	A
Natica hamiltonensis Tate	A
Xenophora cf. tatei Harris	BW
Turritella tristira Tate	N
Mathilda pagoda sp. nov.	A
Potamides nullarboricum sp. nov.	R
Seraphs sp.	BB
Cypraea sp.	A
,, subsidua Tate	A
Trivia sp.	HR
Phalium cf. textile (Tate)	R
Cymatium cribrosum (Tate)	A
Siphonalia tatei Cossman	A
Fusinus senticosus (Tate)	A
,, simulans (Tate)	A
? Fusinus sp.	BB
Lyria sp.	A
Voluta sp.	A
Scaphella pagodoides (Tate)	A
,, tateana (Johnston)	B
Olivella angustata (Tate)	A
Conus dennanti Tate	BW
,, ligatus Tate	BB
Semiactaeon microplocus Cossm.	N

Cephalopoda :

Aturia australis McCoy	BW
Nautilus geelongensis Foord	A
Nautilus sp.	A

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EXPLANATION OF PLATES.

PLATE VI.

Fig. 1.—**Bombax sturtii**, Ett., Cape Riche. Nat. size.
Fig. 2.—**Ecionema glauerti**, sp. nov. Hamersley River District. Holotype, Circ. nat. size.
Fig. 3.—**Caminus parvistoma**, sp. nov. Hamersley River District. Holotype, Circ. nat. size.
Fig. 4.—**C. nitidus**, sp. nov. Hamersley River District. Holotype, X $\frac{4}{3}$.
Fig. 5.—**Cydonium ramuliferum**, sp. nov. Hamersley River District. Holotype, Circ. nat. size.

PLATE VII.

Fig. 6.— **Discodermia gigantea**, sp. nov. Albany. Holotype. $\frac{2}{5}$ nat. size.
Fig. 7.—**D. tabelliformis**, sp. nov. Hamersley River District. Holotype, $\frac{3}{4}$ nat. size.
Fig. 8.—**D. tabelliformis**, sp. nov. Sectional view of Holotype. Circ. nat. size.

PLATE VIII.

Fig. 9.—**Discodermia retepora**, sp. nov. Hamersley River District. Holotype. Nat. size.
Fig. 10.—**D. tumulosa**, sp. nov. Hamersley River District. Holotype. Nat. size.
Fig. 11.—**Neosiphonia fungiformis**, sp. nov. Clay Pit near Racecourse, Albany. Holotype. Nat. size.
Fig. 12.—**N. fungiformis**, sp. nov. Side view of wall of Holotype. X$\frac{3}{2}$.

PLATE IX.

Fig. 13.—**Neosiphonia fungiformis**, sp. nov. Hamersley River District. Paratype. Nat. size.
Fig. 14.—**N. glauerti**, sp. nov. Hamersley River District. Holotype. Nat. size.
Fig. 15.—**Thecosiphonia lovosa**, sp. nov. Hamersley River District. Holotype. Circ. nat size.
Fig. 16.—**Thamnospongia neoclavellata**, sp. nov. Hamersley River District. Holotype. X$\frac{4}{3}$.
Fig. 17.—**T. subglabra**, sp. nov. Hamersley River District. Holotype. Circ. nat size.
Fig. 18.—**T. subglabra**, sp. nov. Hamersley River District. Paratype. Circ. nat size.

PLATE X.

Fig. 19.—**Thamnospongia subglabra**, sp nov. Hamersley River District. Tectotype. X5.
Fig 20.—**Ragadinia placentiformis**, sp. nov. Hamersley River District. Holotype. Nat. size.
Fig. 21.—**Platychonia tertiaria**, sp. nov. Hamersley River District. Holotype. X$\frac{4}{3}$.

PLATE XI.

Fig. 22.—**Verruculina albanyensis**, sp. nov. One mile from Warriup Homestead, Albany. Holotype. X$\frac{4}{3}$.
Fig. 23.—**Dactylocalyx simpsoni**, sp. nov. Albany. Holotype. X2.
Fig. 24.—**Hemicardium**, sp. Cape Riche. X$\frac{7}{5}$.
Fig. 25.—**Cardium arcaeformis**, sp. nov. Albany. Mould. Holotype. Nat. size.
Fig. 26.—**C. arcaeformis**, sp. nov. Cast. Nat. size.
Fig. 27.—**C. arcaeformis**, sp. nov. Squeeze in plasticine. X$\frac{3}{2}$.
Fig. 28.—**Cellana jutsoni**, sp. nov. Albany. Holotype. X$\frac{4}{3}$.
Fig. 29.—**Mathilda pagoda**, sp. nov. Aldinga Bay, S. Aust. Holotype. X$\frac{3}{2}$.
Fig. 30.—**M. pagoda**, sp. nov. Aldinga. Paratype. X$\frac{3}{2}$.
Fig. 31.—**Potamides nullarboricum**, sp. nov. Aldinga, S. Aust. Holotype. X$\frac{4}{3}$.
Fig. 32.—**P. nullarboricum**, sp. nov. Aldinga, S. Aust. Paratype. X$\frac{3}{2}$.
Fig. 33.—**P. nullarboricum** sp. nov. Cape Riche. Mould. Paratype. Circ.nat size.

PLATE VI.

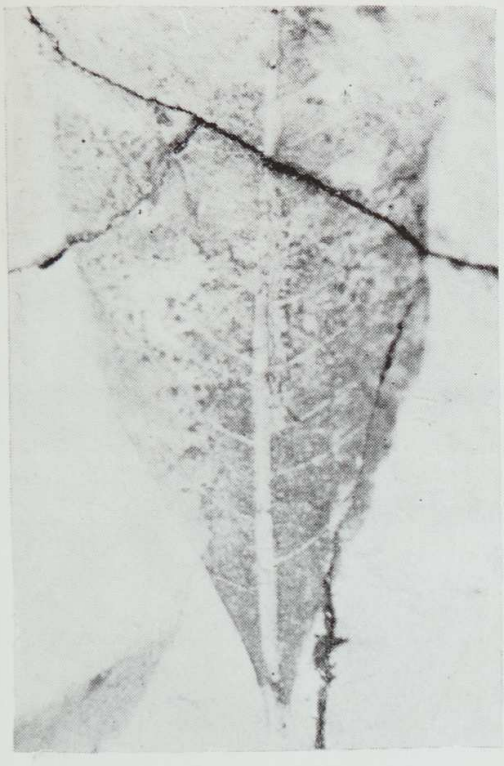

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PLATE VII.

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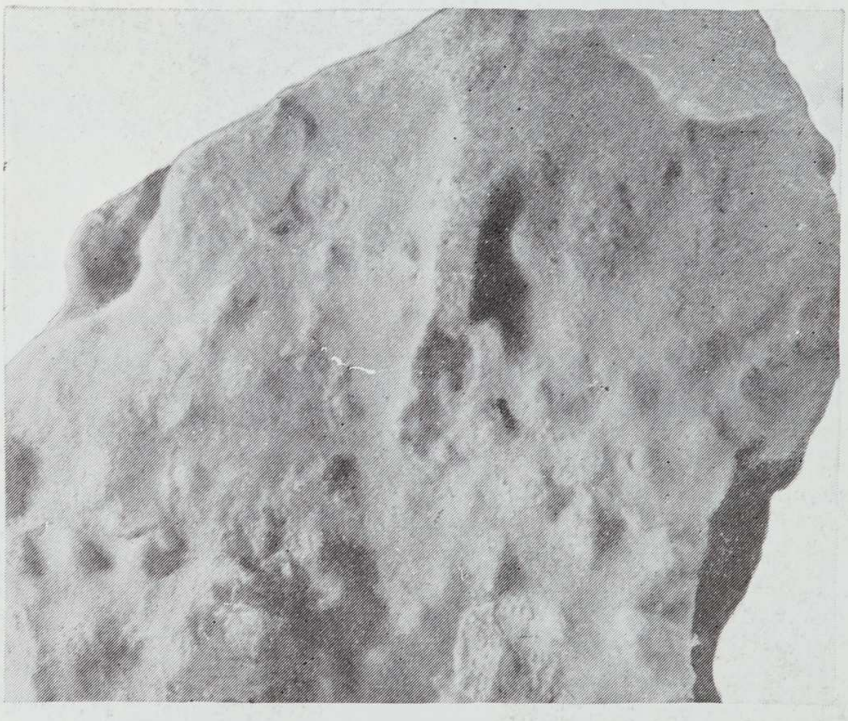

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PLATE VIII.

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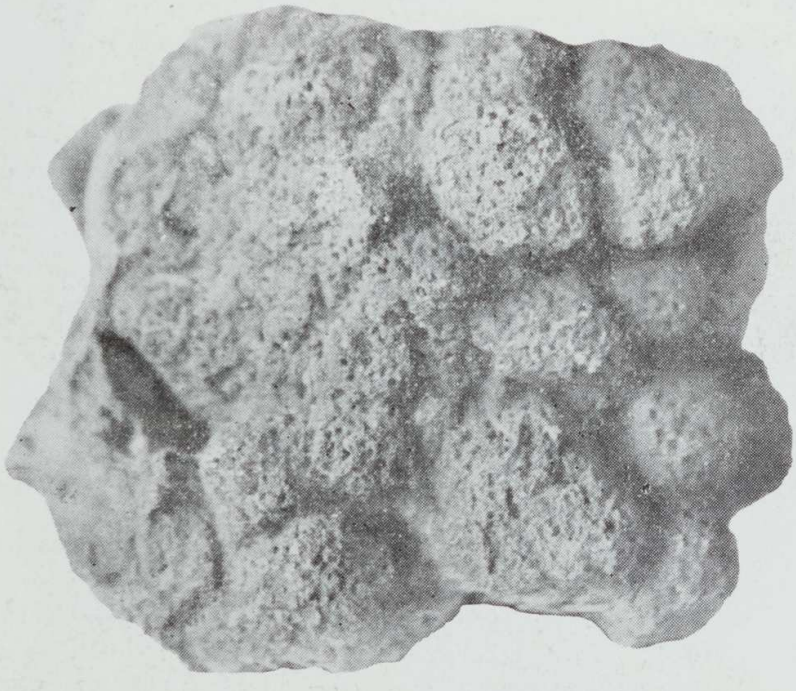

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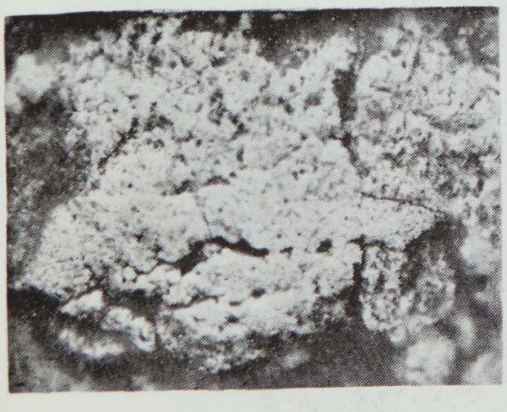

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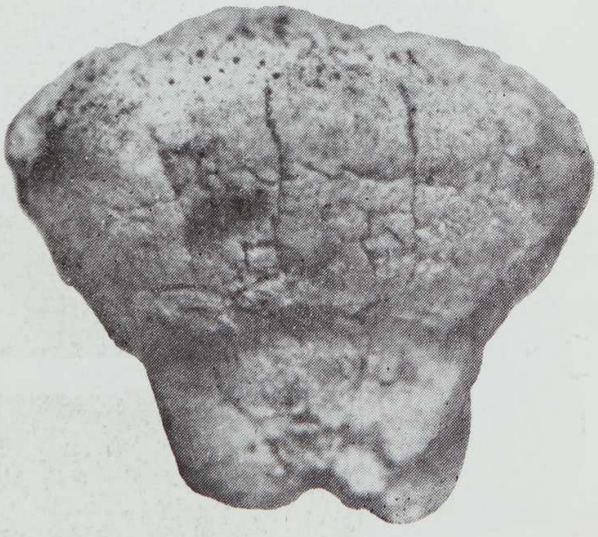

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PLATE IX.

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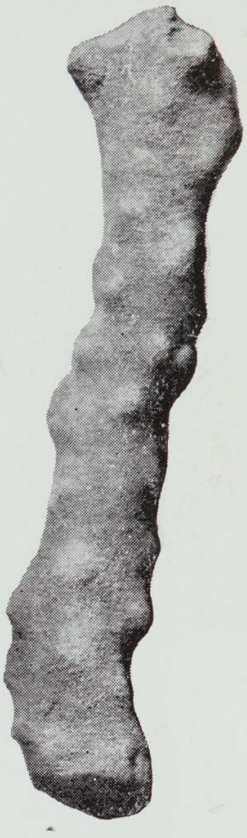

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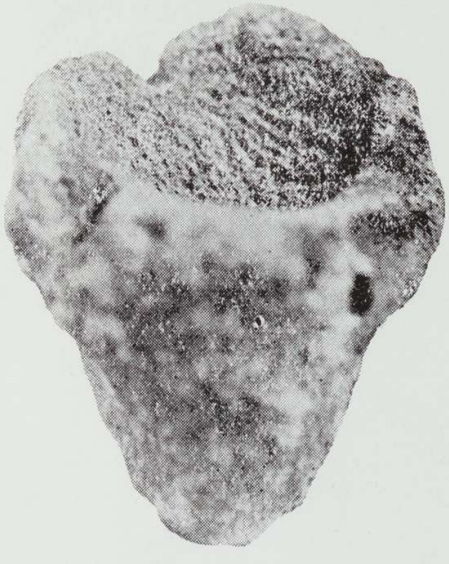

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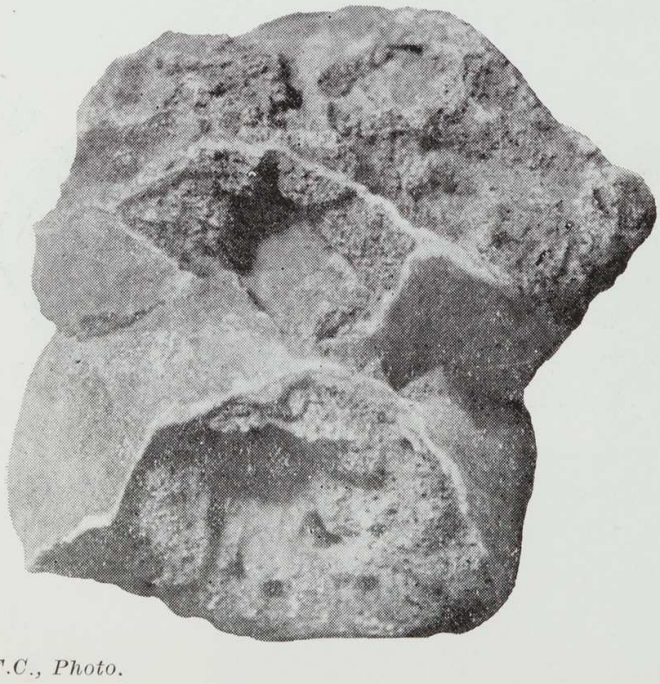

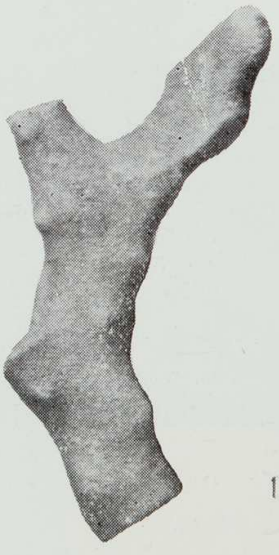

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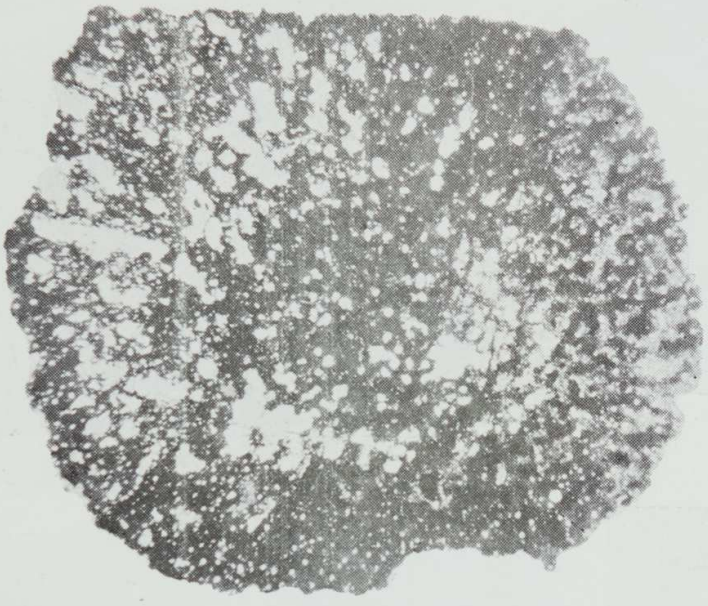
PLATE X.



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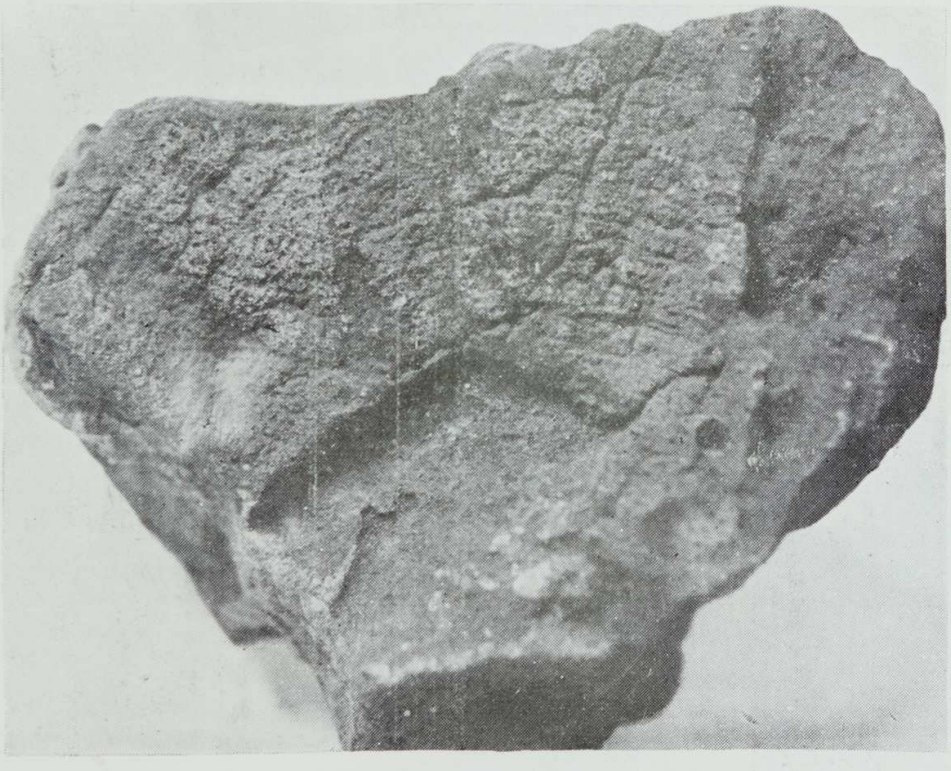

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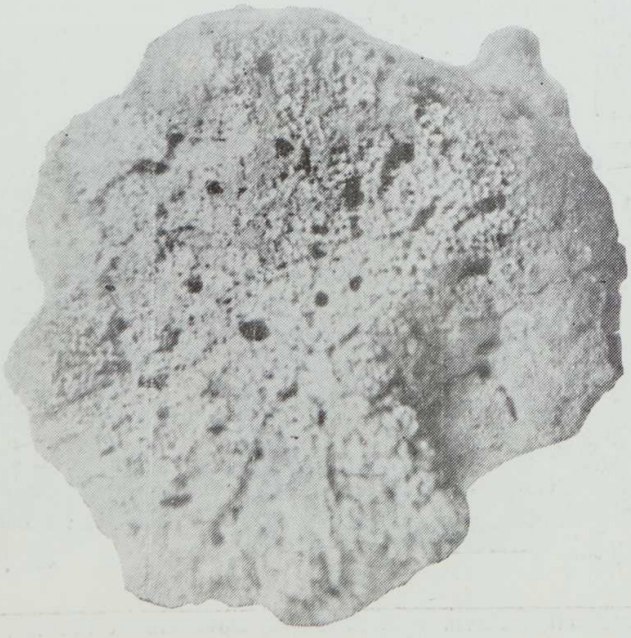

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PLATE XI.

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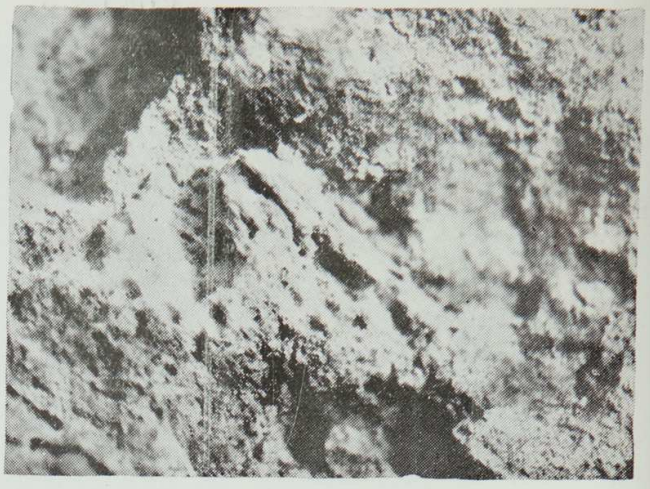

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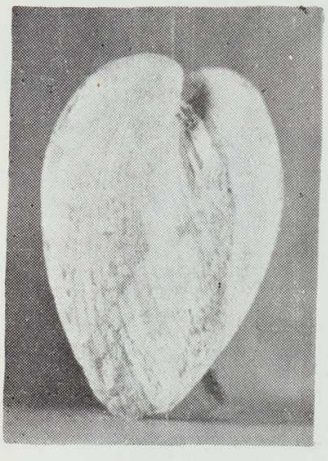

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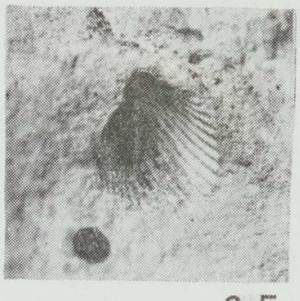

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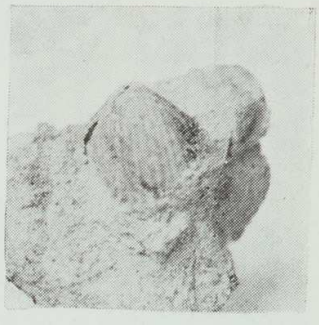

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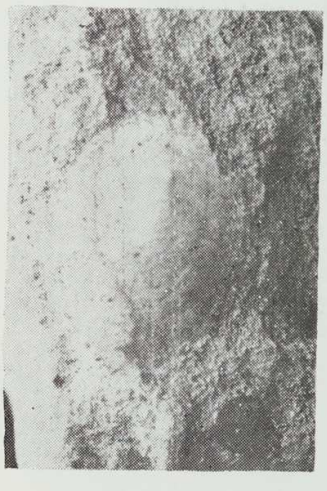

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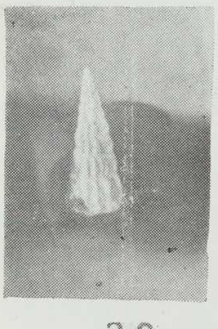

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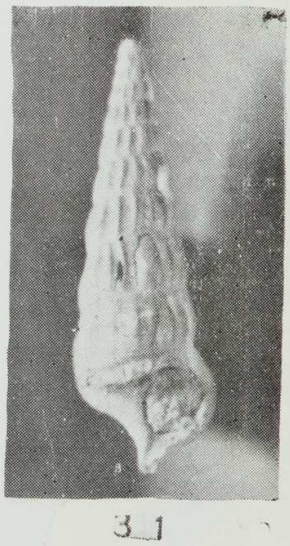

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